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Dredging, Swan River, Colorado

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by

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Operations for the extraction of gold from the gravels of this river, were started about ten years ago, at which time it was attempted by means of hydraulic elevators, later by means of the early type dredge, Risdon design, of which three were installed, and later still, an early type Bucyrus Dredge. These all resulted in failure, same alleged to have been due to impossibility of reaching bed-rock; small yardage capacity; and fraility of design. These have been overcome in the latest type of dredge constructed by the Bucyrus Company, description of which follows later.

Dredging here, differs from that in California, and most places, owing to the fact that the digging must be done on the original channel of the stream; the course of the stream at the time of the deposition of the gold. The present stream is at times, several hundred feet off original channel. As practiced elsewhere, the entire area is dredged. Here, away from the channel, dredging could not be conducted at a profit.

VALUING GROUND.

By means of the Keystone type of drill, a line of drill holes across the valley, are drilled every half mile, this depending upon the judgment of the engineer. The holes in the line are spaced 50 to 100 feet apart. If spaced 100 feet apart, and values shown are high, it is customary to put a hole down between, as a verification of the indications. The report of a hole (copy of one is hereto attached) shows the value of sections of the hole,

formation encountered etc., from which a cross-section of the lines is made. (A typical cross-section is attached). Having this section, a cross-section of the cut which would be made by a dredge can be approximated, taking as the base line of the section, a line on bed-rock, the width of which would depend on the values as shown by drill holes. For slope of section, take two in one, having the depth of gravel from holes, the width at surface is ascertained, and consequently area of section. From this, having the distance between the lines of holes, the approximate cubical dredging contents of the property to be purchased is determined. Having the values shown by the holes, it is an easy matter to get an average value per cubic yard for the ground. With a dredge of 3,000 cu. yds. capacity, conditions such as are encountered here, cost of operating per cu. yd. should be between four and five cents. The life of a boat, with seven month seasons, is approximately seventeen years. Knowing the above factors, the probable net profit in the venture is afforded. In valuing ground it is well to knock off 10 to 40% of values shown by drill holes, depending upon character of bed-rock, and location of values.

DRILLING.

For the operation of the drill, three men are required, a fourth part of the time. They are the driller, helper, panner, and teamster. If two drills are in operation, and not too far apart, one panner and one teamster will do for both drills. Wages paid these men are as follows.

Driller, $4.00 per day of eight hours,
Helper, 3.25 " " " " "
Panner, 3.00 " " " " "
Teamster, 3.00 " " " " ".

Drilling costs, averages $1.22 per foot. Average time required to drill one foot of hole, outside diameter of casing 7 1/4inches, including moving and setting up of drill etc. is 15 minutes. Depth of holes averages 46.8 feet.

The driller keeps a record of formation encountered, reporting this and an accounting of the manner in which the time is consumed. The panner reports the number of colors found, turning into the office the black sands and colors in seperate bottles, same for assaying. In front of hole , a platform is placed, over which is placed a canvas mat so that any colors dropping from the pump, during the process of pumping, will be caught and retained. The slimes are poured from the pump into a box 6 ft. long by 1 ft. in breadth and depth. This is done until a section eight feet in depth is attained, when a second box is put in use. Length of sections decrease as bed-rock is approached. The panner reports the amount of slimes from the section, which is called the "measured excavation." The slimes are now rocked in a rocker, the tailings thrown away, and material retained in the rocker panned. Some engineers re-treat the tailings, but this can hardly be considered advisable, as what can't be caught in the rocker, wont be caught in the boat. The panner pans off all but the black sands, which carry the values. These too are now seperated and dried, and turned into the office.

RUNNING THE SAMPLE.

The black sands are poured into a dish, and in the same manner as panning, reduced to a small amount. This is in case the panner in separating the sands from the colors, has permitted some of the colors to go over with the sands. The reduced amount of sands, are placed in a small porcelain crucible, and the colors added. As the colors are dry, in putting them in with the wet sands, care must

be taken to see that the colors become thoroughly wet and sink, otherwise they will float off. This done, HNO_3 is added and heated slightly. This helps clean the gold and dissolves the iron filings from the drill bit. It is next thoroughly washed, and after , a drop of mercury added. Some water must be in the crucible, so that in shaking, the gold and quick reach the bottom and amalgamate. When satisfied this is complete, remove amalgam from sands, and place in an annealing cup, being sure to wash off all particles of sand. This done, add nitric acid, and heat very slightly. The mercury will be dissolved, leaving the colors. Wash thoroughly, dry slowly and throughly, (to prevent spitting when drying, add a little alcohol at the last) and anneal. When cool, weigh. Having the values taken from a known amount of ground, it is calculated and expressed in cents per cubic yard.

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FACTORS of IMPORTANCE in REPORTING on a DREDGING PROPERTY.

Gold: Coarse or fine , clean or rusty.

Bed-rock: Sedimentary or plutonic, decomposed or undecomposed.

Gravel: Glacial or sedimentary.

Boulders: Presence or absence. If gravel is of glacial origin, greater probabilities of boulders of large size.

Clay: Detrimental; hard to wash and apt to rob gold.

Dykes: If any to what extent.

Water Supply: Source of; quantity available; possibility of floods or freshets.

Power: Possibilities of.

Fuel: Cost; value as; quantity of.

Conformation of ground.

Climate.

Altitude.

Length of working season.

Distance from railroad.

Means of transportation from railroad.

Season of year hauling and and construction work had best be done.

Condition of road.

Available labor supply; experienced or unexperienced.

Wages paid in district.

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OPERATING.

The operating of a dredge requires eleven men, three shifts of Three men each, a shoreman and dredge-master. The crew of three men, comprise a winchman, motorman, and oiler. The winchman operates the boat from winch-room, by means of a system of levers and the electrical end by a system of switches. He must see that the ladder is at a proper level for the filling of the buckets, be careful of caves, and above all, clean the bed-rock. Extra large boulders must be removed so the hoppers wont block. The motorman looks after the machinery on bow end of boat, the oiler ~~oiler~~ on stern end, stacker , and all machiney on upper deck. The shoreman digs dead-men holes, for the anchoring of bow and stern lines, cuts and burns all brush covering the ground to be excavated, digs holes for erection of poles to carry the transmission lines, etc. The dredge-master, directs the crew in both the operation, and repairs.

Wages paid:

Dredge-Master,	$150.00	per month.
Winchman,	4.00	per day of eight hours.
Motorman,	3.50	" " " " "
Oiler,	3.00	" " " " "
Shoreman,	3.00	" " " " " .

The dredges operating here, were designed and built by the Bucyrus Company, of South Milwaukee, Wisconsin. They are of the elevator type, electrically driven, and have the open type bucket chain, a bucket having a capacity of 9 1/2 cubic feet. Designed to dig 48 feet below water level. Capacity , 3,000 cubic yards per day, but by speeding up the bucket line, this has been increased to 4,500 cubic yards. The boat was designed to cut its way through a bank ten feet above the water level, but as the character of the

ground here is such that it caves, we carry as high as a 15 to 20 ft. bank.

The material elevated by the buckets, passes into a hopper from which it is fed into a revolving screen, in which the washing takes place. A perforated pipe, ten inches in diameter, furnishes the water at a high pressure. The fine material which includes the gold , passes through 3/8 inch holes in the screen, into the distributor, from which it passes over the tables. The slope of screen is 1 3/4 inches to the foot. Slope of tables 1 1/2" to the foot. Material failing to fall into the screen hopper, falls into save-all, located inside well-way. This is composed of iron bars on edge, spaced about 1 inch apart. The coarse and fine material are separated by these bars, the fine passing through on to tables covered with riffles of the same design as on the main tables. The coarse material falls into the well-way. The tables or sluices are made of sugar pine, this material being soft does not split on nailing, and when moist, swells, making a tight joint. The sluices are covered with riffles, the riffles laying at right angles to flow of water. A cross-section of a riffle, is upper side 1 1/2 inches; lower side 1 3/4 inches; width 1 1/2 inches. The top is covered by a steel plate 1/4 inch thick, which extends 1/4 inch beyond the lower (or down) side of the riffle. This produces an eddying of the water, and causes the gold and amalgam to deposit beneath it. Enough water must flow over the tables, to keep the riffles clean and sufficiently free to have space for the deposition of values. In the screen, the section next to the last, is the nugget section. This is perforated with 1 1/4 inch holes. The last section having 10 inch square holes, is for separating the large from small rocks, the larger ones greatly injuring the belt, thus reducing its life. This is caused by the large rocks rolling down the belt and hitting the

belt over the idlers. The large rocks consequently pass out of the end of the screen into a chute, which empties at the side of the boat. The material passing throughthe 10 inch holes, are elevated by the belt and stacked.

The movement of the boat is controlled by the stern-line, bow-line, and two spuds, known as the digging and walking spuds. When digging, the digging spud is down, and the bow end of boat moved back and forth across the cut, by the bow-line, the spud acting as a pivot. This continued until bed-rock has been reached and cleaned, when it is necessary to take a step ahead. To do this, the boat is in such a position, that the walking spud when dropped, is nearer the face of cut than the digging spud. The digging spud is now raised, the boat turned on the walking spud as a pivot, and when the digging spud is at the required distance ahead, it is dropped, the walking spud raised, and they are then ready to begin on another cut. Here, we limit the steps to 6 feet, as in taking longer steps the bottom is liable to be left in a rolly condition, thus  , the knolls marked X carrying values, as here, the values lie over the bed-rock. In California, upon draining a dredge pond, the above conditions were found to exist, consequently thousands of dollars had been lost.

What is known as a "Progress Map" is made, to show the progress made by the boat. The ground is laid off in squares of 100 feet, and on the ground, at points corresponding to the crossing of the lines on the map, marking off these squares, stakes are placed. From these stakes, weekly measurements are made and plotted on the map. The depth dug above and below water level, is daily reported. In front of the boat on the bank, two flags are placed. These flags mark the width of the cut on bed-rock. Having the width of cut on bed-rock, width at surface, and total depth, getting from Progress

Map, the progress made during the week, the weeks cubical yardage is calculated. This is called the bank measurement. To check this, the number of buckets dug, is registered, and allowing each bucket a certain yardage, we get what we term the bucket measure.

To determine the width to be dug in bed-rock, we keep a panner on the boat. This man feeds quick to the tables daily, loosens the sands in the riffles to give the values a chance to sink , and does the panning. When digging on bed-rock, he takes samples across the face, and the results of panning these, show how wide must be the cut, and consequently determines the placing of the previously mentioned flags.In this channel dredging, this is a matter of great importance.

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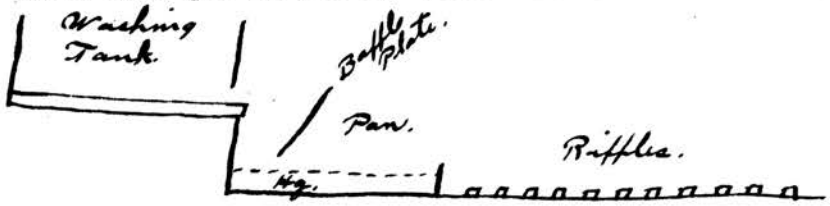
CLEANING UP.

In cleaning up, after the buckets have been raised and emptied, the water is permitted to flow for a short time until the tables are washed clean of all coarse material. Next, the riffles from every alternate table, are removed and placed on the adjoining table and by means of a hose, washed. The hose is then taken to the head of the table, the water carrying the sands and gravel down to the stops, of which there are two to the table, one half way down, and theother at the end. A man at each of these stops, by means of a shovel, keeps pushing the material back from the stops, thus permitting the values and quick to settle. Owing to the heaviness of the amalgam, most of it remains at the head of the table, and can be scooped up. When the material behind the stops is reduced to a sufficiently small amount, it is gathered up and put in the washing tank. When this process has been gone through with all the tables, it is now time to go ahead with the washing tank. The tank is five feet long, by two and one half feet wide, by two feet in depth. On a level with the bottom, is an opening 4 inches wide by 3 inches high, same being controlled by a gate. Slope of tank bottom is about 1/2 inch to the foot. This empties into a pan (iron) of such design as shown below in cross-section.



The material, being washed slowly from the tank, strikes a baffle plate, passes over the mercury bath, the amalgam, nuggets, and any free gold sinking into the silver, and sands passing over the riffles. This material in the pan is constantly stirred to permit this settling. The material caught in the riffles is later removed

and put back on the tables. When as much of the sand is washed off the bath as is deemed advisable, the whole is removed to a pot, the sands separated, and panned into the tank, thus getting any values the sands might contain. The amalgam, by means of acanvas, is strained thus seperating the free quick. The dry amalgam is weighed, and is now ready for the retorting and melting.

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RETORTING and MELTING.

Preparing the Retort:- Chalk is mixed with enough water to make a good paste same being plastered around inside of retort, when it is ready for the amalgam. The amalgam can be tied up in a rag and placed in the retort, or paper can be put in the retort, and the amalgam placed in it. A thick paste of flour and water is next prepared, and spread around rim of retort cover so as to make it as nearly air-tight as possible, after being clamped on. From top of retort extends a pipe, which is bent downwards, the end of which is in a basin filled with water. Half of the pipe above referred to, is within a second pipe of larger diameter, through which water circulates, thus forming a water jacket, to condense the distilled mercury. The distillation of the mercury, is done over a fire in the open, because of the danger of breathing any that might escape. When all the quick has been driven off, which can be told by there being no further flow into the basin, the retorted gold is dumped into a pan, broken up into small pieces to facilitate cooling and later the melting. When cooled, it is weighed.

Melting:- An hour before time for melting, the crucible (of graphite) is placed in the hot gases above melting furnace, and the whole heated to a high temperature, to save time in the melting. As to kind and quantity of flux used:

Flux:- Two parts Powdered Borax,

One " Bicarbonate of Soda.

Quantity used:- 1/2 pound flux to 100 ounces of retorted gold.

The melting requires from 1 1/2 to 2 hours. To tell when ready to pour, stir with a carbon rod, if thick on the bottom, a longer time is required. If the whole is free, it is ready to pour. In the meantime, the mould must be cleaned, heated, and just before the pour, smoked. This is done by burning some waste, saturated with

coal-oil beneath it, when upturned. It prevents the gold adhering to the mould. When hardened, remove from mould and cool quickly in water, the easier to remove any adhering slag. It is next pickled in a lead bath, with a solution of one part HNO_3 and two parts H_2O. The pickling simply makes a better looking bar. The bar is weighed and shipped to the Denver Mint.

Average reduction in weight from Amalgam to Bar 54.6%,

" " " " " Retort to Bar 4.39%.

DESCRIPTION of PRINCIPAL PARTS

taken from Specifications.

The over-all dimensions, can be had from plan and elevation attached.

BUCKETS:- The buckets have three front, and two rear eyes, and have a pitch of 32 1/4 inches, from center to center of pins. Bottom is a single casting of specially prepared open hearth chrome steel. Horizontal part of bottom is 2" thick, inclined part 1 1/8" thick. Sides of buckets at point of contact with ears of upper tumbler are filled in solid. The hood is made of pressed steel plate. The lips are of manganese steel, maximum width 12". The corners have raised projections 1 1/2" high. Digging angle of lip is about 38 degrees. Pins are of high carbon steel, 4 7/8" in diameter. All rivets are one inch.

UPPER TUMBLER:- Is six-sided, each side being provided with a chrome steel sprocket plate, this plate being bolted to tumbler casting, and prevented from moving by two tongues, with corresponding grooves in the tumbler casting. The side lugs are cast on the sprocket plate.

The upper shaft is of open hearth steel, diameter in tumbler 16", and in bearing 14". The tumbler is keyed to the shaft, by four large gib-headed keys. End movements of the keys is prevented by filling pieces set in the key seat.

LOWER TUMBLER:- Made of specially treated open hearth steel. The tumbler faces are lined with chrome steel wearing plates, fastened to the tumbler casting by counter -sunk rivets.

The tumbler flanges , have manganese steel wearing plates on each corner, tapering from 5/8" to 1 1/4" in thickness and about 13" long over all. The tumbler, which is in halves, is securely fastened together by means of links, to prevent their spreading on the shaft. Lower tumbler shaft is 10 1/4" in the middle, 9" in the journals, made of nickel steel, bored hollow. Keyed to tumbler. The journals run in renewable self-aligning bearings, held in steel casting boxes riveted to ladder. The caps of these boxes are bolted to planed joints, and a heavy tie rod, extending from one ladder end casting to the other.

LADDER FRAME:- The ladder frame is steel, of the plate girder type. The top of the ladder is provided with a steel deck, and a saddle-back at its lower end for discharging the material spilled by the buckets in their passing up the ladder, at a point of the ladder where it may be again picked up by the buckets.

Lower end of ladder is fitted with steel casting brackets, with renewable self-aligning boxes, the brackets being tied together as specified previously, under description of lower tumbler. The upper end of the ladder frame is fitted with heavy steel casting brackets, extending out laterally and resting in supporting bearings on the main gantry. The supporting bearings are concentric with the upper tumbler shaft, and the bearings from the shaft rest directly upon the steel casting ladder ends. The caps of the ladder bearings, when bolted on, embrace the the cap and lower part of tumbler shaft bearings, and also ladder brackets, securing the whole construction firmly in place on the main gantry. The contacts between the tumbler

shaft bearings and ladder end are narrow , and provided with lateral play, making the whole arrangement self-aligning. Fastenings are provided for attaching two 1 1/2" cables for safety hangers.

For supporting chain of buckets, the ladder is supplied with rollers, all 14" diameter. Rollers are of high carbon steel castings. Two flanged rollers are placed on the upper end of ladder. The base of the flanges on these rollers is 2 1/2" thick, the top 1 1/4" thick. The diameter of the flange is 22". Roller bearings above water are provided with renewable liners, those below, are not. Ladder roller shafts are 3 3/8" in diameter.

MAIN DRIVE:- The upper tumbler shaft, is driven by a steel casting gearing, driven by a 200 H.P. induction motor. The main tumbler gears are 12" in diameter and 2 3/4" pitch. The intermediate shaft does not extend extend between the main gantries, thus leaving open space for the rearward extension of the hopper, to afford ample room for boulders.

HOPPER:- A steel hopper receives the discharge of the buckets and conducts it to the revolving screen. This hopper is lined on all faces subjected to abrasion., by liner plates from 1/2" to 1" thick, depending on location, and is provided with a guard over the top of the ladder and buckets. The liner plates are supported by hangers, permitting easy removal.

SCREEN:- The screen is 38 ft. in length, 5 ft. 10 in. inside diameter. Screen plates of Marine steel 1/2" thick, perforated with 3/8" holes. Near the lower end of screen.

situated a belt of 1 1/4" perforations, to provide for saving the nuggets. The screen projects beyond the after pair of supporting rollers a sufficient distance to provide a course of screen plates having perforations 10" square, through which passes all material to be handled by the stacker.

MAIN WINCH MACHINERY.:- Winch machinery is provided with eight drums, two forward swinging lines, two stern breasting lines, two lines for raising and lowering the spuds, andtwo extra drums.

Extra powerful clutches and gearing are provided for the bow swing drum and the spud hoist drums. Drums for these lines are steel castings. No two drums are operated by the same lever. Gears are all steel, and shafting of forged steel. There are two gear reductions, the gears of the first being cut.

STACKER WINCH MACHINERY.:-This is a special single drum winch, driven by means of a worm and worm gear. This winch is placed at the stern of the dredge, on top of the truss timbers, and directly in line with the rope leading from the stacker hoist block, and is driven by means of a friction clutch from the screen drive counter-shaft.

LADDER HOIST MACHINERY.:- The drum is driven by a friction clutch and gearing, from the motor used for driving the main bucket chain. The large gear on the drum shaft and all pinions used on the drive are of steel. The intermediate gears have steel rings and heavy cast iron centers. Apowerful compound

brake is provided to raise and lower the ladder.

SHEAVES:- On the ladder hoist they are 24" in diameter, have heavy hubs and 3" diameter pins, with bronze bushings. Sheaves for raising and lowering spuds likewise bushed with bronze bushings, and all blocks are provided with compression grease cups, one cup to each sheave. Sheaves carrying ladder hoist ropes are of the same sizeand proportion as the ladder hoist block sheaves. Deck sheaves, breasting line sheaves, spud idler sheaves etc., are 20" in diameter for 7/8" rope, take 2 1/2" pins, and have deep flanges and hubs.

SPUDS:- Are steel, 42" deep, 30" wide, and 65 ft. long. Made up of two webs and two flanges joined by four angles , which are enclosed by four plates. Rectangular in cross-sedtion, smooth on all sides, all rivets being driven countersunk on on theoutside. Spuds are hoisted from the top by means of sheaves and wire ropes, in order to accomplish which, a suitable gantry is provided at the stern of the dredge.

OPERATING:- The different operations of the machinery excepting
LEVERS. those of the stacker winch are controlled by levers arranged in the pilot house,so placed that all the movements of the dredge excepting those mentioned,can be controlled by one man, Levers for the stacker hoist winch, are placed next to the winch at the stern of the dredge.

GANTRY: FITTINGS. Gantry caps and metal fittings for attaching the upper ladder suspension blocks and connecting the timbers are provided for the front, main and rear gantries of the dredge.

SCREEN CASING AND SLUICES, ETC.: A screen casing distributor and sluices of plate steel, are provided, to catch the material from the screen and deliver it to the tables, and to collect material from the tables to be delivered overboard.

STACKER LADDER:- Is of structural steel, and provided to carry a stacker belt 125 ft. between centers.

HULL:- The hull is constructed of fir. It is thoroughly trussed from end to end.

GOLD SAVING TABLES:- The gold saving tables are of wood of the transverse type extending across the dredge from gates in the distributor under revolving screen to gathering sluices at each side.

WATER SUPPLY:- Water supply for washing and sluicing purposes are furnished by one 12" centrifugal pump, direct connected to a 75 H.P. motor. Water supply for hopper, priming pumps, etc. is furnished by one 5" centrifugal pump. A heavy screen will be placed around the suction of the water pump, and is arranged to be raised by block and tackle from outriggers. The screen is in two sections of No. 14 galvanized wire screen, 1/2" mesh.

STACKER:- A 32" Robins conveyor complete, with four pulleys on troughing idlers is provided. The return idlers are placed outside of the lower chord of the stacker frame. The elevator is adjustable in height and is provided with two running boards.

The oil cups on return idlers are placed so that the idlers are readily and easily oiled.

SAND PUMP:- Sand pump is carried, but is not used.

MOTORS:- One 200 H.P. digging motor. Variable speed.
One 75 H.P. pump mptor. Constant speed.
One 75 H.P. sand pump motor.
One 25 H.P. stacker motor. Constant speed.
One 50 H.P. Constant speed, for driving screen and stacker hoist.
One 15 H.P. for priming pump. Constant speed.
One 20 H.P. for winch .
One 2 H.P. motor, for running drill press.

CONTROLLERS:- The controllers are placed in the pilot house, that the operator may start, stop or reverse the variable speed motors.

Respectfully submitted,

HWL/H. H.W. Lahman.

Feb. 23rd, 1910.